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## ***Interactive comment on “Coastal and open ocean aerosol characteristics: investigating the representativeness of coastal aerosol sampling over the North-East Atlantic Ocean” by M. Rinaldi et al.***

### **Anonymous Referee #2**

Received and published: 7 January 2009

Rinaldi et al. report interesting and useful data regarding size-resolved physical and chemical aerosol distributions at Mace Head (MH) and an offshore site in the North Atlantic (CE). The authors' main tenant is that the similarity in the number size distribution and size-resolved chemical composition indicates "homogeneous aerosol physical and chemical properties over a wide region in the marine boundary layer." They also state that this similarity indicates that there are not substantial "coastal artefacts" in their Mace head data. However, based on the results presented in this manuscript, I am not convinced that their interpretation is correct for several reasons listed below; a much

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more quantitative, critical analysis of the data is needed to support these assertions, especially since they seem to contradict the literature.

1. The authors present three aerosol number distribution plots (Fig. 2) as one piece of evidence to show that the MH and open ocean sites are similar, but are they really? The basis for this "similarity" in the manuscript is subjective. What is needed is a quantitative assessment with set criteria to evaluate the degree of similarity or difference in these three data sets. Even when viewed on a log scale, I would argue that the distributions between the two sites are more different than similar. From the number distribution data, there are two data sets that somewhat agree and one that clearly does not (panel b in Figure 2). This is not sufficient to make a broad sweeping statement about homogeneity. Related to this issue, even though sampling was sectorized, what were the synoptic air trajectories during sampling? In order to conclude large scale homogeneity in the MBL (I'm assuming that they're talking about the NE Atlantic, but as stated in the abstract and conclusion this is poorly worded), it is important to have a much larger sampling grid with more stations and seasons covered. Additionally, although the authors performed sectorized sampling and used the criteria that aerosol numbers needed to be low, what does this really tell us about MH versus the open ocean site-that they are "similar" under a restricted set of conditions at a very specific time of year? The air that they've sampled is certainly not purely marine, and local/regional influences at MH are well known (see comment 3).

2. With respect to the chemical size distribution data, it would be useful to see ammonia and nitrate concentration and mass size distribution comparisons since they were reported to be similar between the two sites. Is the WSOC measured at MH really not substantially different from that at CE even though size distributions do not show a perfect match (pg 7, bottom)? From my perspective, I do not see particularly good agreement for any given sampling date. Again, a quantitative assessment would be useful.

3. The authors state "Figure 5 shows that, in spite of the differences between the MH

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and CE samples regarding the contribution of WIOC and the absolute concentrations of coarse mode sea salt and WIOC, the average size-segregated chemical composition is very much the same at the two sites during the observation period. These results are the first direct observations that coastal effects influencing the aerosol chemical composition in marine air masses at MH are small." When I examine Fig. 5, I don't see that the data are "very much the same" and therefore I am not convinced that there are not local/regional emissions affecting aerosol properties measured at MH. Indeed, the literature has clearly demonstrated such influences. For example, continental air containing reaction products from emissions over Europe is episodically recirculated and entrained into the MBL over eastern North Atlantic and sampled during on-shore flow at Mace Head (e.g., Savoie et al. 2002. JGR). Given the prevailing westerly flow at this location, presumably, on average, such continental influences would diminish with distance unwind from the coast yielding a gradient rather than a "homogeneous" distribution of aerosol properties over the region. In addition, emissions of IO precursors from coastal macroalgae have been linked to bursts of new particle production at Mace Head (e.g., O'Dowd et al. 1999, GRL; O'Dowd et al. 2002. Nature). Presumably this local source would influence aerosol physical properties measured at Mace Head on occasion (e.g., under conditions of in-sector flow roughly parallel to the coast or in-sector flow over the off-shore islands). Certainly, selection of periods during which aerosol number concentrations are low would tend to minimize the influences of local/regional emissions from the perspective of the authors' analysis. However, this filtering does not eliminate the influences of these processes on aerosol properties in the region. What is the rationale in focusing an analysis such as this exclusively on the lower end of the distribution in aerosol number concentrations? If the goal is to evaluate the regional representativeness of aerosol properties measured at MH, it would seem more appropriate to interpret the full range of conditions rather than a selected subset thereof.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 19035, 2008.

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